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ONTARIO

Ontario Department of Labour
The Honourable Dalton Bales, Q.C.,
Minister
T.M. Eberlee, Deputy Minister

Research Branch
August 1970

A Proposed Methodology for Cost-Benefit Analysis of Government Sponsored Training-in-Industry

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and
Frank Whittingham

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FOREWORD

Although cost-benefit analysis can be a useful tool for evaluating the success of occupational training, there are many problems in applying it. Because it has been faced with these, the Research Branch of the Ontario Department of Labour is attempting to develop a methodology of cost-benefit analysis appropriate to the Department's training-in-industry activities. This study suggests such a methodology and at the same time clarifies the limitations of the analytical technique.

As in so many discussions of the application of cost-benefit analysis to training, emphasis is placed on the need to support the work with a well-designed information system. Only when data requirements are carefully defined and consistently met is it possible to use a cost-benefit approach for continuing evaluation of training-in-industry in a way that might assist administrative decisions.

The study is based on information drawn from ten projects undertaken as part of the program of the Department's Industrial Training Branch. The study was prepared by Alan Strang, Assistant Research Economist, and Frank Whittingham, Chief Research Officer, Manpower & Standards, members of the Research Branch staff. Other staff members carried out the clerical and secretarial work and assisted by participating in discussions of the many problems dealt with in the paper.

JOHN KINLEY,
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INTRODUCTION

In recent years, a great deal of interest has developed in cost-benefit analysis as a potential aid in the administration of government programmes. An increasing number of goods and services are being produced in the public sector of the economy which means a greater volume of production becomes insulated from the rigours of competitive markets. Consequently, the danger arises that some of the real needs of society may not be met or that they will be met through very inefficient processes. Within the larger "planning, programming and budgeting framework", cost-benefit analysis is viewed as one tool that might be used to reduce the risk of economic inefficiency in government programmes.

In the more specific area of government assisted manpower training in Canada, cost-benefit analysis is considered an important evaluative tool because one of the key objectives of the programme is to facilitate economic growth.[1] A contribution towards attainment of this goal is achieved by bringing about a more efficient allocation of labour through occupational training, labour market information and mobility programmes.

Since a primary purpose of manpower policy in Canada is to facilitate economic growth, an important criteria for evaluating success is the extent to which the benefits accruing from the programme exceed the costs associated with it. In this paper, a method for undertaking cost-benefit analysis for one aspect of the government's manpower policy is presented. The specific acticity is the on-the-job training programme in Ontario which is sponsored jointly by the Canada Department of Manpower and Immigration and the Ontario Department of Labour.

In the following section of this report, a brief general discussion of the use of cost-benefit analysis and its limitations is undertaken. Also, several important shortcomings of the specific approach taken to the problem in this paper are pointed out. After this general discussion a detailed description of the methods used to define and measure costs and benefits with respect to a government supported on-the-job training project is presented. In the concluding part of the paper, benefit-

[1] For a statement on objective of Canada's manpower policy, see: Annual Report of the Department of Manpower and Immigration, 1968-1969, Ottawa, Queen's Printer, p.3.

cost ratios for ten projects obtained by applying the methodology are reviewed and suggestions for a continuing programme of work are made. In addition, the methodology described in the report is summarized into a number of simple equations in an Appendix.

Limitations of Cost-Benefit Analysis

At the outset, it should be stressed that there are certain limitations associated with cost-benefit analysis. In this regard, the major problems are in the field of measurement. Costs and benefits are measured in monetary terms. Consequently, the intangibles - those costs and benefits which cannot be given a dollar value - are not explicity allowed for in the analysis. This inability to deal with intangible factors may create undesirable biases in the ratios of benefits to costs and, therefore, limit their usefulness. The problem can be illustrated with reference to a person who was unemployed and on welfare prior to entering an on-the-job training project. Assuming this person successfully completes the project, the frustrations of being unemployed and living on welfare are removed. Such an effect represents an important social benefit, but it defies monetary measurement.

Also, there may be cost items that cannot be effecively brought into the analysis. For example, if a person has to relocate to undergo training, there are tangible moving expenses; but there are also the intangible costs to a trainee and his family of leaving their friends and neighbourhood to locate in a new place.

In addition, there may be income redistribution effects and multiplier effects associated with government expenditures on manpower training projects that could represent either additional costs or benefits. Again, it is not possible to isolate and place price tags on these side effects. The best that one can hope for is that the various immeasurable costs and benefits will tend to cancel out. To the extent that cancellation does not occur, the ratio of benefits to costs will be distorted.

Further, when it is possible to isolate and price the costs of a training project, the price data used may only provide an approximation for true costs. This problem arises because the cost concept used in the analysis is "opportunity cost". This concept will be elaborated in a later section, and, hopefully, it will suffice at this time to note that because of market imperfections observed prices may not reflect the

true opportunity cost to society of using resources in a specified way.

Another difficulty the analyst must face is the attribution problem. To what extent are observed benefits attributable to the training project relative to other factors such as previous education, training and work experience of trainees or their aptitudes? This is a fundamental methodological problem that is very difficult to circumvent. One solution is to use a "control group". Through this approach, the pre-training-post-training wage differential for trainees is compared with wage increases experienced by a group of persons who did not take training but who have demographic and economic characteristics that are similar to those of the trainees. By comparing the experience of groups that are similar in all respects, except training experience, all other factors except the training variable are theoretically held constant and differences in earnings and employment patterns are attributable to training.

In the analysis presented here, the control group technique is not used because of the difficulty of obtaining an adequate control group. There are no central records that would yield the required information on characteristics of non-trainees. One possible source might be records kept for unplaced registrants at Canada Manpower Centres in those locations where training projects are established. However, there would be a number of difficulties in using this source. First, the labour market penetration of the Manpower Centres is low and, second, they tend to service the lower skill groups in the work force. Both these factors would bias this source of information for control group purposes. Also, while a control group in terms of similar demographic and economic characteristics might be obtained, the more subtle characteristics such as initiative and aptitude would remain uncontrolled. Also, how does one obtain a control group for trainees in upgrading projects? The latter refers to persons who were employed by the training firm before entering the training project.

In the work presented in this paper, the simple "before and after" approach is used to measure benefits. The pre-training-post-training earnings differential for trainees is taken as one measure of benefits attributable to training. It should be stressed that this represents a basic limitation of the methodology. The attribution problem is really ignored by assuming observed increases in earnings are the result of the training project alone.

It must be stressed that the "before and after" approach limits the use of the final ratios of benefits over costs to comparing projects within a programme. It should be possible to compare ratios between projects in the same programme to assess factors leading to a favourable or unfavourable ratio of benefits to costs; but the approach does not make it possible to compare the overall efficiency of the on-the-job training programme with other public investment programmes such as regional development or tourism.

Another difficulty with cost-benefit analysis is the need to place costs and benefits on a comparable basis before calculating a ratio. This problem arises because the costs are incurred when a project is implemented but the benefits take the form of a future time stream of benefits. As a result, it is necessary to convert the expected future time stream into a present value figure which necessitates the use of a discount rate. This procedure is discussed in more detail later in the paper; but the reader should be warned at this stage that variation in the discount rate used can cause considerable variation in the final ratio of benefits to costs.

Given the foregoing discussion, it becomes apparent that, at best, cost-benefit analysis is an imperfect tool, and it should be used with caution by the decision maker. In addition to the measurement problems, as an economic measure any ratio of benefits to costs does not allow for the social implications of a training project which may be quite important under certain circumstances. For example, relief from unemployment in a depressed economic area could be an important criteria for the decision maker that would temper any conclusion reached through cost-benefit analysis. In summary, there are other considerations besides efficiency, and it is ultimately left to the programme administrator to decide how much weight to place on cost-benefit analysis relative to other criteria when selecting projects.

MEASUREMENTS OF COSTS AND BENEFITS FOR ON-THE-JOB TRAINING PROJECTS

Training Projects Selected for Cost-Benefit Analysis

Initially, sixteen on-the-job training projects were selected for cost-benefit analysis, but six projects were discarded because of either unique circumstances or insurmountable data problems. Two of the

six projects had been set up in new firms which made cost and labour turnover data difficult to obtain and highly unreliable. In two other cases, no data on the pre-training rates of trainees could be obtained, and for one project the training firm was unable to supply cost data. The sixth project was dropped because the training firm lost several orders and laid off 80 per cent of the graduates just after the training project was completed.

The ten projects analyzed are listed in Table 1. They cover eight industries and are distributed over three regions of the province. As revealed in Table 1, dropouts were a minor problem in some projects, but for one project in the Clothing Industry there were more dropouts than graduates. The projects studied ranged in length from 160 to 1,000 training hours and trainee wage rates ranged from $1.25 to $3.16 per hour.

Costs

The cost concept used in this analysis is "opportunity cost". It involves the concept that when a choice is made other alternatives that might have been chosen are excluded. As a result, the cost of the alternative chosen is really the value of the resources employed in the alternative activity with the highest value. This approach results in certain costs being introduced into the analysis that would not be identified if standard cost accounting practices were employed. For example, one cost of a training project is the trainee wage cost; but there may be an additional cost in terms of foregone earnings which represent the difference between the wage a person could have earned elsewhere and the wage received as a trainee. The latter is an opportunity cost that should be taken into account.

Three sources of costs associated with an on-the-job training project are analyzed. These are government costs, costs to the trainee and costs incurred by the training firm. It should be noted that while costs to the training firm are examined benefits that may accrue to the firm from its investment in training are not dealt with in this report. Consequently, the ratios of benefits to costs presented later in the analysis reflect only social benefits and government costs.

TABLE 1
TRAINING PROJECTS SELECTED FOR COST-BENEFIT ANALYSIS

No.	Industry	D.D.P. Area	Skill	Graduates	Dropouts	Total
1.	Electrical Products	Eastern Ontario	Production and Prototype Assemblers	45	8	53
2.	Electrical Products	Eastern Ontario	Tool Assemblers and Machine Operators	19	1	20
3.	Printing & Publishing	Eastern Ontario	Collators	8	3	11
4.	Textiles	Eastern Ontario	Knitting, Dyeing and Finishing Machine Operators	58	0	58
5.	Textiles	Eastern Ontario	Process Operators, Electricians, Instrument and Maintenance Mechanics	106	0	106
6.	Miscellaneous Service	Metropolitan	Heavy-Duty Equipment Mechanics	27	3	30
7.	Food and Beverages	Metropolitan	Cheesemakers	13	4	17
8.	Transportation	Metropolitan	Bus Drivers	144	10	154
9.	Clothing	Eastern Ontario	Sewing Machine Operators	63	67	130
10.	Metal Fabricating	Niagara	Valve Grinding Machine Operators	30	0	30

Government Costs

Under a contract for a training project, the government directly reimburses the training firm for part of the cost it incurs.[2] Federal Government support is restricted to vestibule training and can reach 100 per cent of instructors' salaries and 50 per cent of trainee wages for this phase of the project.[3] However, the maximum weekly Federal Government payment to cover trainee wage cost is $48.00 per trainee, and this is paid only for trainees who have been in the labour force for at least three years. Payment to cover the cost of instructors' salaries in the vestibule part of a project is based on a trainees to instructor ratio agreed to by the training firm and the government. For example, if the ratio is six to one, then, for every six trainees the firm would be reimbursed the cost of one instructor's salary. Provincial Government support for vestibule training can be a maximum of 50 per cent of trainee wages and cannot exceed $48.00 per week per trainee. Also, this payment will only be made for trainees who do not meet Federal Government eligibility criteria.

Neither the Federal nor Provincial Government will subsidize instructors' salaries during the shop-training part of a project.[4] Also, the Federal Government will not subsidize trainee-wage costs during shop-training, while the Provincial Government will reimburse the training firm from 10 to 25 per cent of the trainee-wage costs during this phase.

In addition to government assistance for instuctor and trainee-wage costs, various administrative costs are incurred by both levels of government. At the provincial level, a development officer visits the company to discuss and develop the training project. Also, a schedule of training must be drawn up, trainee registration forms processed, monthly statistics compiled and invoices paid. Further, monitoring visits are made to the firm during the life of a project.

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[2] The provisions for government participation in training-in-industry discussed in this part of the paper were those that applied when the training projects selected for analysis were implemented.

[3] "Vestibule" is that which may be conducted in a classroom or area remote from the production area or conducted on the production line provided that the machine on which training is given is not producing saleable items.

[4] "Shop-training" is on-the-job training that involves producing saleable items.

The costs of these activities were estimated by applying the amount of time spent on them by the responsible individuals against their respective salaries. Travel expenses arising from a training project were also included as a cost item.

One government cost item that could not be allowed for at the provincial level is the proportion of general overhead costs of the Ontario Department of Labour's Industrial Training Branch attributable to the on-the-job training programme. As a result, it was not possible to calculate an average overhead cost per training project. This omission will result in an understatement of total costs, and consequently, in some upward bias in the final ratios of benefits to costs.

Time is also spent by Federal Government personnel in reviewing projects submitted for approval by the Industrial Training Branch. Monitoring visits are also made. The proportions of salaries and overheads, as well as other related expenses incurred as a result of the on-the-job training programme in Ontario were estimated for 1968. This estimate was divided by the number of Ontario projects during 1968 to obtain an average Federal Government cost per project. It should be noted that federal administrative costs per project vary only slightly by size of project, and, therefore, the averaging procedure should not cause any bias. In calculating provincial administrative costs, however, costs were calculated for each project because these costs rise as project size increases.

Employee Cost

There may be a cost to the employee of undergoing training. If his hourly wage rate during training is less than the hourly wage rate before training, then training involves an opportunity cost to that person. He is giving up a part of his potential income for the opportunity to undergo training. Thus, the employee cost of a training programme is measured by the difference between training and pre-training hourly rates times the number of hours spent in training for each employee. In certain types of training programmes, foregone earnings of trainees can be important. For the projects analyzed here, however, the latter was not a significant cost factor. Because training took place in an industrial setting, competitive industrial wage rates

were paid. As a result, in very few cases was a trainee's pre-training hourly rate greater than the hourly rate received during training.

Costs to the Training Firm

For analysis of a training project, one is concerned about those costs which arise solely because of the decision to train, that is, costs that would be avoided if the training project was not implemented.[5] Also, ideally, one should include only the firm's incremental costs that are attributable to the training project. As will become evident later in this section, however, it has been necessary to use several procedures in examining costs of training to the firm that take one away from the ideal measure.

Costs for the firm are broken down into two categories: net direct costs and overhead costs. In attempting to come to grips with these items, the basic measurement problems were compounded by the inadequacies of records kept by firms which, at times, has forced the use of approximations. These problems are discussed in the next two sections.

Net Direct Wage Costs to the Training Firm

The gross direct cost to the firm of the training programme consists of the wages paid to the trainees and instructors. This is the product of the hourly wage rates and hours spent in training of these people. The data on wages and hours were supplied by the training firms.

However, not all of the time the trainee spends in training is non-productive. During the shop part of the training, the trainees may actually be producing some output. This output can be sold by the firm and used to offset the costs of training. Thus, when a saleable product is produced, the gross wage cost of training must be reduced by the productivity of the worker.

It was assumed that the value added by a trainee after completion of a training project is at least equal to his wage rate, that is, for every dollar he earns, he adds at least one dollar to the value of the product.

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[5] Richard W. Judy, "Costs: Theoretical and Methodological Issues", G.G. Somers and W.D. Wood (eds.), Cost-Benefit Analysis of Manpower Policies (Kingston: Industrial Relations Centre, Queen's University, 1969), pp. 16-29.

An attempt was then made to determine how much of the trainee-wage rate was earned by the trainee during training, that is, for every dollar paid to the trainee how much of that dollar did he earn. In a few cases detailed productivity records were kept for each individual trainee and these were utilized. In most cases, however, especially when the trainees were working on an automated production line, it was impossible to get accurate productivity estimates for the individual trainees. In these situations an estimate was obtained of the average productivity of the trainees in a skill group and this figure was used for each individual trainee.[6]

The productivity data were applied to trainee wage costs to get a measure of value added by the trainees during training. This measure was then subtracted from gross wage costs to obtain a wage cost for the firm net of trainee productivity. This direct wage cost to the firm was reduced further by the amount of government reimbursement to get the net wage costs of training

Overhead Costs

In addition to direct wage costs, the training firm has other overhead costs arising from the training programme. There is a cost of administering the programme. The personnel department must interview and hire trainees, record their hiring, fill in trainee registration forms, record details of training and administer the programme. This cost was measured in time expended at the appropriate salary rates.

Other costs should also be taken into account. Fuel, power and floor space are used and must be costed. The machinery used in training depreciates during use and this must be costed. Although some of the materials used are sold in the form of final output, there is an increase in the amount of scrap produced which is attributable to the training programme.

Firms in the sample had different ways of keeping records and none explicitly recorded all the costs of training. In a few cases, it was possible to calculate the costs from records but, for the majority of

[6] It must be stressed that these estimates of trainee productivity are very crude. When detailed records did not exist it was necessary to develop estimates through interviews with foremen and supervisors associated with the training project.

TABLE 2

GOVERNMENT REIMBURSEMENT AS A PERCENTAGE OF TOTAL COSTS OF THE TRAINING FIRM

Project No.	Industry	Government Reimbursement as Percentage of Total Firm Cost
1.	Electrical Products	33.71
2.	Electrical Products	22.69
3.	Printing & Publishing	19.91
4.	Textile	39.11
5.	Textile	28.68
6.	Miscellaneous Services	24.03
7.	Food & Beverages	32.41
8.	Transportation	19.75
9.	Clothing	13.11
10.	Metal Fabricating	45.78

firms, a different approach had to be used. These firms kept data on the overhead costs, that is, fuel, power, floor space, depreciation etc. as a proportion of direct labour cost. The costs were measured by using this relationship between overhead costs and direct labour costs. This approach assumes that overhead costs are a fixed proportion of direct labour costs, that is,

$$O_c = a\ L_c$$

where O_c represents the overhead costs, L_c represents the direct labour costs and "a" represents the constant ratio between these.[7]

Relationship Between Government Reimbursement and Total Costs of the Training Firm

The relationship between the reimbursement of the Federal/Provincial Governments and the total costs incurred by the training firm indicates how much of the actual cost of the training programme the government was actually subsidizing. The percentage of total cost paid by government ranges from 13.11 per cent to 45.78 per cent (see Table 2). Although for half of the projects, government paid one-quarter or more of the total cost of the project, in no case does the government pay as much as half of the costs.

Benefits

In this work the benefit from government assisted on-the-job training focussed upon is the consequent improvement in productivity. The latter arises from an improvement in occupational skills and a more efficient allocation of labour that results from the investment in training. The increase in productivity is measured by the difference between the trainee's pre-training and post-training wage rate which may be an inadequate approximation because of market imperfections. Also, it must be stressed that the assumption underlying this approach is that observed wage differentials are attributable to the investment in training. This assumption restricts the use of the final ratios of benefits over costs to comparing projects within a

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[7] Ideally, the relationship should be a marginal one, $MO_c = a\ ML_c$, where MO_c is the marginal overhead cost and ML_c is the marginal direct labour cost.

programme.[8]

A number of problems arose in obtaining adquate approximations for the benefit depicted above because of the characteristics of trainees and the paucity of data. These difficulties and how they were dealt with are discussed below.

Pre-training-Post-training Wage Differentials

A number of problems were encountered in assigning pre-training wage rates. When a person was employed either with the training firm or a different firm immediately prior to entering a training project the hourly rate in the job held prior to training was taken as the pre-training rate. For persons unemployed prior to training, the hourly rate received in the last job held was assigned as the pre-training rate.

A problem arose, however, when a trainee was outside the labour force prior to training. In this case, a "peer group rate" was assigned as the pre-training wage rate. For this procedure, it is necessary to assume that when a firm recruits trainees for a project the persons selected in each skill group are, on average, equally capable and productive. With this assumption, it is possible to assign to a trainee, who was outside the labour force prior to training, the average pre-training wage rate of those persons in the labour force prior to training who were recruited for the same skill group in the training project. Also, this same peer-group rate procedure was employed to assign a pre-training wage rate for a trainee who was in the labour force prior to training, but for whom no wage rate was recorded in available records.

Peer-rates were used, however, only when new labour force entrants or other trainees without pre-training wage rates constituted a small proportion of the total number of trainees in a project. When they constituted a large proportion of the trainees in a project, an alternative procedure was utilized. In this situation, the average starting rate for an unskilled worker (male or female) in the area of the training project was assigned as the pre-training wage rate. These rates are available from the Ontario Department of Trade and

[8] Benefits from the training project can also accrue to the firm. However, no attempt is made in this analysis to measure such benefits.

Development.[9]

The post-training rate is defined as the hourly wage rate received by the trainee immediately after completion of the project. An exception to this procedure occurred when a trainee was still on a probationary period after completing the project. Under these circumstances, the hourly rate received at the end of the probationary period was used as the post- training wage rate. Also, any union negotiated rate increases for a job that occurred during the training period were ignored.

Before leaving this discussion of benefits based on the pre-training-post-training earnings differentials, the treatment in this analysis of dropouts from a training project should be noted. It is tempting to argue that persons who drop out of a project will receive some benefits from the training received and, accordingly, the observed benefits based on earnings differentials for graduates should be adjusted upwards. However, for the latter to have any validity would require that dropouts make use of their incomplete training experience. While the evidence on this point is limited, a small follow-up survey of dropouts suggests that very little use is made of the training received. Only 3.7 per cent of the dropouts contacted were employed in a job similar to their occupation of training.[10] In light of this statistic, the decision was made to eliminate dropouts for purposes of calculating benefits attributable to a training project.

Projection of Earnings Differentials

After the wage rate differentials have been calculated, it is necessary to project into the future because the benefits from training accrue over time. In this work, the approach taken to calculating a stream of benefits involves two time periods. The first time span involves the period between the date a trainee completes a training project and the date of the last contact with the training firm to obtain information on number of graduates still with the company, etc. For this period, it is possible to calculate the stream of benefits based on

[9] Industrial Directory of Municipal Data, Field Services Section Industrial Development Branch, Ontario Department of Trade and Development.

[10] This statistic is based on unpublished data collected by the Research Branch, Ontario Department of Labour.

the experience of each individual trainee. For the time period after the date of the last contact, however, it is necessary to employ a more aggregative approach. But before discussing the actual calculations made, there are several difficulties involved in projecting a time stream of benefits that require attention.

The projected stream of benefits must be adjusted for factors that will reduce the returns on the investment made in a specific occupational training project as one moves further into the future. Examples of such factors are mortality and retirement. A more difficult question, however, concerns whether or not the time stream should be adjusted for graduates who leave the training firm. The answer to this question will depend on whether these workers continue to use the occupational skill they acquire in their next job. For those graduates who leave the training firm and do not take training-related employment, the investment made does not generate any benefits from society's point of view because these persons are merely taking jobs that would have been filled by persons who had not gone through a training project. In this analysis an adjustment for graduates who leave the training firm was made. A follow-up survey of graduates who left their training firms revealed that 20.3 per cent had left the labour force, 18.3 per cent were unemployed and 61.4 per cent were employed. However, only a very small proportion of the mobile graduates, 3.6 per cent, were using their training skill.[11] Given this last statistic, it was decided to adjust the future time stream of benefits to allow for graduates who leave the training firm.

Calculation of Benefits for Initial Time Period

In this time period, information was available for each individual trainee and it was possible to calculate the benefits on an individual basis. The benefits were calculated by multiplying the trainee's hourly wage increase attributed to training by the number of hours he worked for the training firm in that period.[12] The sum of these individual benefits is the trainee benefits for the initial time period.

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[11] These statistics are based on unpublished data collected by the Research Branch, Ontario Department of Labour.

[12] An 8 hour day and a five day week were assumed.

Calculation of Benefits for Second Time Period

For the second time period, which involves a projection into the future, the trainee benefits had to be dealt with at an aggregate level. Initially, the average hourly benefit for those graduates still employed by the training firm was calculated. This is the trainee benefit to be projected into the future. However, this benefit will be affected in future periods by mortality and turnover of trainees which must be allowed for in the projection.

The mortality factor was found by using statistical tables based on age and sex [13] to decrease the number of trainees producing benefits in each year. The adjustment was based on the average age of the trainees in the group. Also, the time stream of benefits was adjusted to allow for graduates leaving the firm. It was decided not to project the actual observed separation rate of graduates as new employees tend to have an initially high separation rate. The rate used was the separation rate for non-office employees for the training firm. This rate is a measure of the success of the firm's hiring policies, of the comparability of its wage structure and of the employer/employee relationships. All of these are important in determining future turnover. The number of employees producing benefits was reduced annually by this separation rate.

For each year, the benefit was calculated by multiplying the average hourly benefit by the number of working hours in a year and by the adjusted number of graduates still employed by the training firm.

Time Period for Projection of Benefits

The length of the time period for which benefits are calculated can affect the size of the ratio of benefits to costs. If a very short time period is used, the benefits generated by the training project in that period may not be great enough to cover the costs. If a very long time period is used, the benefits may be greatly overestimated and may lead to an unrealistic benefit-cost ratio. Thus, the question of what is a suitable time period for projecting benefits is a critical one

The true time period for projecting benefits equals the period covering the length of life of the training skill. As long as the training

[13] Provincial and Regional Life Tables, 1960-62, Dominion Bureau of Statistics, Cat. No. 84-517.

skill can be used, benefits will continue to flow from the training project. However, it is difficult to determine with any preciseness the actual length of life of a training skill. The most important factor determining the life of a skill is technological change. If technology changes in such a way that a particular machine or skill is made obsolete, then the benefits of the training project end. This is particularly true of short-term on-the-job training which does not provide as broad a skill base as apprenticeship or more general institutional classroom training. However, changes in technology cannot be foreseen and allowed for in a projection. It cannot be stated that a skill will last for the rest of the trainee's working life or that it will become obsolete a few years after training. Thus, no firm statement can be made as to the length of the period that benefits will accrue from a training project.

For the purposes of this report, the flow of benefits was calculated for three time periods - ten, fifteen and twenty years after the end of training. This enables the administrator to make his own subjective decision as to the length of life of the training skill. As an additional aid, the payback period was calculated, that is, the period for which benefits must flow for the cost of the training project to be recovered.

Benefits Excluded From the Analysis

From the foregoing discussion of benefits, one might conclude that the definition of benefits is too narrow. This restrictive approach, however, reflects a preference for concentrating on the improvement in productive capacity attributable to the investment in training. The alternative would be to focus on the effect of the investment on total ouput or national product.[14] If the latter orientation is used, it becomes necessary to allow for vacuum and multiplier effects. These potential benefits are ignored in the analysis because of the decision to use the more limited productive capacity framework. The reason for this preference is the nature and purpose of the projects analyzed.

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[14] This distinction between a productive-capacity orientation and an actual-output orientation is made by Hardin in his review of cost-benefit analyses. See: Einar Hardin, "Benefit-Cost Analyses of Occupational Training Programmes: A Comparison of Recent Studies", G.G. Somers and W.D. Wood (eds.), Cost-Benefit Analysis of Manpower Policies, (Kingston: Industrial Relations Centre, Queen's University, 1969), pp. 97-118.

TABLE 3

SOCIAL BENEFIT-COST RATIOS AND PAY-BACK PERIOD FOR TEN ON-THE-JOB TRAINING PROJECTS

No.	Industry	Cost ($)	10 year B/C Ratio	15 year B/C Ratio	20 year B/C Ratio	Payback Period (years)
1.	Electrical Products	19,514	1.85	2.11	2.23	3.4
2.	Electrical Products	8,444	3.04	3.12	3.13	0.9
3.	Printing & Publishing	3,085	7.60	8.85	9.47	0.7
4.	Textile	29,406	0.21	0.26	0.28	Never
5.	Textile	33,988	2.47	2.69	2.77	1.7
6.	Miscellaneous Services	14,136	2.93	3.06	3.08	1.2
7.	Food & Beverages	5,130	4.25	4.81	4.87	1.0
8.	Transportation	40,362	13.28	15.37	16.40	0.3
9.	Clothing	11,552	1.19	1.19	1.19	2.2
10.	Metal Fabricating	47,637	1.49	1.83	2.02	5.5

They are on-the-job training projects and one of their main purposes is to facilitate economic growth by improving productivity.

Discounting of Benefits

In order to calculate a ratio of benefits to costs, it is necessary to place them on a common basis. The costs of a training project are incurred when it is implemented, but the benefits from the investment that the project represents accrue in the future. Since the return on the investment takes the form of a future time stream of benefits, it is necessary to discount this stream of benefits to a present value figure.

The benefits were discounted by a social discount rate. The rate most accepted in the literature is the yield rate on government bonds.[15] The average yield on long-term government bonds over the ten-year period, 1958-67, was calculated.[16] This rate, 5.18 per cent, was used to discount the social benefits. After the stream of benefits had been discounted at the appropriate rate, it was added to give the total present value of social benefits from the training programme.

Benefit-Cost Ratios

In this part of the paper, benefit-cost ratios for ten on-the-job training projects are presented. The ratio used is termed social benefits to government costs and was obtained by applying the methodology outlined in the previous sections. The ratios are presented for three different time projections of benefits - ten years, fifteen years and twenty years after training.

The three sets of ratios are shown in Table 3 along with the calculated payback period. With the exception of project 4 in the Textile Indusry, the ratio is greater than unity for each time period. It should be noted that as the time period used for projection is in-

[15] See: Economic Analysis of Public Investment Decisions: Interest Rate Policy and Discounting Analysis, Hearings before the Subcommittee on Economy in Government of the Joint Economic Committee, Congress of the United States, Ninetieth Congress, Second Session, 1968.

[16] This was a weighted average over the period using the average of yields at mid and end-month of all direct Government of Canada bonds, denominated in Canadian dollars, due or callable in 10 years or more, excluding perpetuals, and the amount outstanding for each month of Government of Canada direct and guaranteed securities with more than 10 years to go to maturity. The material for calculating this discount rate was provided by the Bank of Canada.

TABLE 4

SOCIAL BENEFIT-COST RATIOS CROSS-CLASSIFIED BY SELECTED VARIABLES

Project No.	Industry	Social Benefit/ Government Cost (20 year period)	Labour Turnover Rate[1]	Proportion of Trainees Unemployed Prior to Training	Length of Training Project (hours)	Average Hourly Wage Differential[2]
1.	Electrical Products	2.24	9.0	37.5	216	.01
2.	Electrical Products	3.14	25.0	20.0	438	.38
3.	Printing & Publishing	9.47	8.1	18.1	400	.47
4.	Textile	0.28	5.0	0.0	218	.00
5.	Textile	2.77	13.6	6.5	235	.10
6.	Miscellaneous Service	3.08	21.3	0.0	440	.25
7.	Food & Beverages	4.87	10.0	0.0	375	.28
8.	Transportation	16.40	8.1	14.9	245	.43
9.	Clothing	1.19	52.0	66.9	400	.09
10.	Metal Fabricating	2.02	4.4	0.0	960	.13

[1] This is the separation rate of the firm, that is, the number of non-office employees terminating employment as a percentage of all non-office employees for a twelve-month period.

[2] This is the average hourly pre-training-post-training wage differential for graduates from a training project.

creased the size of the benefit-cost ratio increases only slightly. Also, the relative ranking of each project remains the same.

In only one of the projects was the government investment never paid back. Also, for eight projects, costs were recovered in the first four years after training.

The benefit-cost ratios for the twenty year period after training are cross-classified in Table 4 by a number of factors that could have an influence on the ratios. These are the labour turnover rate of the training firm, the proportion of trainees in a project that were unemployed prior to training, the length of the training project, and the average hourly pre-training-post-training wage differential for a project. Other factors such as average age of trainees and proportion of trainees married were excluded from Table 4 because of the high degree of inter-relationship between these variables and the firm's labour turnover rate.

A rank correlation coefficient between each variable and the social benefit-cost ratio was calculated. For the labour turnover rate the coefficient was .04 which shows very little relationship.

Also, the influence of the proportion of trainees unemployed prior to training is negligible. The rank correlation coefficient for this variable was .06, which suggests that the measurable social benefits relative to public costs of retraining the unemployed through on-the-job training projects may be as favourable as the results obtained from upgrading projects. The rank correlation coefficient between the length of training and the social benefit-cost ratio equalled .12 which, again, suggests little relationship.

When the social benefit-cost ratio was related to the average hourly wage differential, a rank correlation coefficient of .92 was obtained. This very high coefficient indicates that the best single predictor of a favourable social benefit-cost ratio is the magnitude of the pre-training-post-training wage differential.

Suggestions for Further Cost-Benefit Analysis

The work presented in this report should be viewed as a proposed methodology for developing benefit-cost ratios for government sponsored on-the-job training projects. The term "projects" should be stressed because the ratios can only be used to compare the efficiency

of projects within a programme. A basic assumption is that observed benefits are attributable only to the investment in training. Consequently, a ratio of benefits to costs should not be used to compare the efficiency of on-the-job training programmes with other public investment programmes.

There are two outstanding questions. First, given the limitations, is cost-benefit analysis as applied to on-the-job training projects a valid aid to the programme administrator? If this question is answered affirmatively, the second issue that arises concerns the required information system. For the analysis to be meaningful, the methodology adopted must be consistently applied. In turn, this requires an information system that will generate the necessary information on a consistent format for each project. To achieve this consistency, it would be necessary to set down standard definitions of costs and benefits and build these into the information system associated with an on-the-job training programme

After the above tasks were completed, it would be possible to undertake a comprehensive programme of cost-benefit analysis in various industries and types of training projects on an ex-post basis. The ratios produced could be examined in relation to the various characteristics of the projects. Through this experience those factors that have the greatest effect on the ratios and are most predictive of success or failure could be isolated. The next step would be to consider possible cost-benefit analyses of training programmes on an ex-ante basis as a guide to future government investment.

APPENDIX

METHODOLOGY FOR SOCIAL BENEFIT-COST RATIO

1. Cost

The social cost of a training programme can be summed up in the formula:

$$C = G_c + E_c$$

that is, total cost, C, consists of government cost (G_c), employee cost (E_c)

a) *Government Cost*

This cost can be described as

$$G_c = R + A_p + A_f$$

where R = Government reimbursement for graduates

A_p = Provincial government administration cost

A_f = Federal government administration cost

The joint federal/provincial government reimbursement for graduates can be broken down further, as follows:

$$R = \alpha\left[\frac{(V_I \cdot H_V)N}{r_t}\right] + \beta\left[\frac{(S_I \cdot H_S)N}{r_t}\right] + k\left[V_T \cdot H_V\right]N + d\left[S_T \cdot H_S\right]N$$

where V_I is the hourly rate paid to the instructor during vestibule training as agreed upon in the contract between the training firm and the federal/provincial governments.

S_I is the hourly rate paid to the instructor during shop training as agreed upon in the contract.

V_T is the hourly contract rate to be paid to the trainee during vestibule training.

S_T is the hourly contract rate to be paid to the trainee during shop training.

H_v is the number of hours spent in vestibule training by each graduate.

H_s is the number of hours spent in shop training by each graduate.

N is the number of graduates.

r_1 is the trainee/instructor ratio as agreed upon in the contract.

α, β and d are the proportions of the cost that the federal/provincial governments will reimburse, as agreed upon in the contract.

b)*Employee Cost*

The employee cost is given as

$$E_c = \sum_{i=1}^{i=n} \left[(v_{Ti} - w_{Ti}) H_v + (s_{Ti} - w_{Ti}) H_s \right] + \sum_{j=1}^{j=n} \left[(v_{Tj} - w_{Tj}) H_{vj} + (s_{Tj} - w_{Tj}) H_{sj} \right]$$

where v_{Ti} is the actual hourly rate paid to the i-th graduate during vestibult training.

w_{Ti} is the pre-training hourly rate of the i-th graduate.

H_v is the number of hours spent in vestibule training by each graduate.

s_{Ti} is the actual hourly rate paid to the i-th graduate during shop training.

H_s is the number of hours spent in shop training by each graduate.

v_{Tj} is the actual hourly rate paid to the j-th dropout during vestibule training.

w_{Tj} is the pre-training hourly rate of the j-th dropout.

s_{Tj} is the actual hourly rate paid to the j-th dropout during shop training.

H_{vj} is the number of hours spent in vestibule training by the j-th dropout.

H_{sj} is the number of hours spent in shop training by the j-th dropout.

2. Social Benefits

Social benefits are calculated at two levels: at the micro level in the initial time period and at the macro level in the second time period.

(i) Initial Time Period

At the micro level, benefits are

$$B_{mT} = \sum_{a=1}^{a=n} (b_a \cdot H_a)$$

where B_{mT} is the total benefit for all graduates for the initial time period.

b_a is the difference between pre- and post-training hourly rates for the a-th graduate.

H_a is the number of hours the a-th graduate was employed by the training firm in the initial time period.

(ii) Second Time Period

$$B_{MT} = \sum_{i=1}^{i=n} B_{MTi}$$

and

$$B_{MT} = (h_M \cdot b_M) n_i \qquad (i = 1, 2, \cdots, 20)^*$$

where B_{mTi} is the total benefit to graduates in the i-th year after graduation.

b_m is the average wage benefit per graduate per hour for those graduates still with the firm at the beginning of the macro period.

n_i is the number of graduates still with the firm in the i-th year.

h_m is the number of hours worked per year. This is assumed to be 2,000 hours, that is, 40 hours per week and 50 weeks per year.

Also, $n_i = n_{i-1} - [n_{i-1} \cdot r_{di} \cdot r_s]$ $(i = 1,....,20)$*

where r_{di} is the probability of death among the trainees in the i-th year (based on the sex and average age of the trainees).

r_s is the separation rate of the training firm.

(iii) Total Social Benefits

These are given by

$B_T = B_{MT} + B_{MT}$

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* with adjustments for the short macro period in the first year.